

CASE REPORT

AN INTERESTING CASE OF CRACKER BLAST INJURY HAND

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INTRODUCTION: Blast hand injuries represent a wide spectrum of wounds associated with a distinct pattern. Thumb is the most common finger to get injured in blast injuries (IP joint being commonest and least being CMC joint¹) with next common being index finger.¹ The mechanism of injury varies from Hyperextension to hyper abduction with severity ranging from lacerations to even complete amputation. The average economic loss per injured worker was INR. 6900 for workers in the wage range of INR.5400 to 19,200.²

CASE REPORT: 60 year old male manual worker sustained cracker blast injury to his dominant right hand(under alcoholic influence picked up a burning cracker) and was brought to our emergency room on the same day (after 10 hours of warm ischemia time)³ On a primary survey, we found a traumatic disarticulation of the thumb at the level of CMC joint (very rare-2% of all injuries) with a non-viable thumb and gross contamination along with a circumferential laceration at the base of the right index finger with severely comminuted fractures of proximal and distal phalanges of index finger (grade 3 C open fracture) with compromised vascularity of the right thumb as well as index finger. The problems were nonviable thumb with complete disarticulation of thumb/1st CMC joint, Tendon and muscular injury with complete skin loss and grade 3-C open fracture of index finger with compromised vascularity. Replantation was deferred considering the warm ischemia time and clinical appearance.

Options were:

1. Thumb terminalisation and primary closure with conservative treatment for index finger fracture.
2. Thumb terminalisation and primary closure with k wire fixation for index finger.
3. Excision of the devitalized thumb with pollicisation of the index finger with k wires and CMC fusion.⁽⁴⁾
4. Primary closure with secondary toe-to-hand procedures.⁵

The patient had a severe structural disruption of the thumb and a moderate to severe injury of the index finger (grade 3 C open #) with mangled dominant right hand. The patient was willing for any salvage procedure. Our management was to excise the devitalized thumb with pollicisation of index finger with k wires and CMC fusion. The principle is restoration of the anatomical position of thumb and functions of the hand (hook, pinch, grasp) with the key movement being opposition.

Surgical Technique: Order of repair being inside out, bone was fixed first. The wound was washed with 6 liters of normal saline⁶ to remove dirt/ Gunpowder by high volume low pressure

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irrigation technique (pulsatile lavage facility is not available in our hospital⁷) to remove all contamination followed by index finger debridement along with excision of necrotic skin and muscle of the wound until fresh bleeding was noticed.⁸ Saline lavage was repeated again. Then metaphyseal osteotomy of base of the 2nd metacarpal was done and Trapezium scored. Finally rotational transfer of the index finger for 160 degrees was done and k wires (littler's pollicisation⁹) were fixed taking care not to injure the vascularity any further. Modified Pulvertaft technique¹⁰ was used for tendon transfers from Flexor Pollicis Longus to Flexor Digitorum Superficialis of the index finger along with transfer of Extensor Pollicis Longus to Extensor Digitorum Communis slip of the index finger. (Fig. 1, Fig. 2). Wound irrigation done frequently and subsequently closed by modified shoe lace technique.¹¹

The skin flap from the dorsal aspect of the excised thumb was utilized as a proximally based subcutaneous transposition flap to cover the reconstructed first web space. After that, the remaining skin from the palmar side was debrided & fashioned to achieve nearly 60-70% soft tissue coverage as a primary procedure.

Post Op: Inj. Heparin was started immediately (5000 IU sc BID) along with Inj. cefotaxime 1g IV bid & Inj. Gentamycin 80 mg IV bid and the limb maintained in elevated position with a supportive plaster slab applied in functional position.

Eventually fingertip went for gangrene (Fig. 3, Fig. 4) although the immediate post-operative x-ray (Fig. 5) show that the wires are in situ. Hence amputation of the distal phalanx was done on day 10 followed by partial amputation (at the level of fracture) of proximal phalanx of the pollicised index finger on day 25 leaving behind a stump of proximal phalanx of index finger (partial) along with second metacarpal bone as the new thumb (Fig. 6, 7) The remnant defects were found to be covered with healthy granulation tissue on day 35, when split skin grafts from the ipsilateral thigh was harvested and the final soft tissue closure completed. Complete soft tissue coverage with healing was obtained only after 6 to 7 weeks from the time of injury. K-wires were removed at the end of 12 weeks.

Repeat debridements were done on day 5, day 10 and day 18. There was some loss of both dorsal as well as palmar skin due to infection and necrosis. Pus cultures were taken from the wound and sent for sensitivity on day 5. Cultures were positive for staph. Aureus sensitive to Cefotaxime, Gentamycin, Ciprofloxacin and Oxacillin, moderately sensitive to cotrimoxazole while resistant to Chloramphenicol /Erythromycin. Appropriate antibiotics were administered for the patient.

Active range of motion exercises and passive stretching exercises of the fingers and wrist along with rubber band exercises were initiated after 3 weeks for the middle, ring and little fingers, but only after 6 weeks for reconstructed thumb. Strengthening exercises with rubber ball was initiated after 10 weeks along with cane stretch exercises for forearm and wrist. Isolation and integration exercises were tried but because of gangrene and subsequent loss of the transferred finger at the level of fracture were not of much use. The joints were kept supple by wax therapy and ultrasound massage was used for breaking up simple adhesions.

Follow Up: The case was prospectively followed up after discharge from our hospital at weekly intervals in the first three months and monthly intervals for the first year and once in 3 months

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up to 36 months and all the functions of the hand were assessed using DASH score. At the end of final follow up the first web space was well preserved (Fig.: 8, 9, and 10). There was minimal scar contracture and the protective sensations of pain and temperature were well preserved while the fine touch was diminished in the stump of new thumb compared to the opposite side. Movements in the reconstructed thumb stump were restricted to 20 to 30 deg. at the end of final follow up but the patient had a useful opposition function of the thumb stump while the rest of the fingers showed full recovery of flexion and extension.

RESULTS: The results of the procedure were evaluated using "The Disabilities of the Arm, Shoulder and Hand (DASH) Score" system. The DASH score¹² was 61.1 at the end of 3 weeks, 42.6 at the end of 6 months and the final score improved to 30.6 at the end of 3 years of follow up. The patient was able to open a door, lift a bag, hook a bag or pinch a key with mild discomfort as early as 3 months post operatively from the day of injury and radiographs were also taken (Fig. 11) while at the end of 3 years, he was able to pinch a key, open a door, lift a bag, hook a bag and perform even lifting a chair effortlessly. During final follow up, the first carpo metacarpal region showed a solid clinical as well as radiological union (Fig. 12) and the patient was happy that he could take care of activities of daily living with minimal discomfort and continue his job as a manual laborer with mild difficulties.

DISCUSSION: Napier has written, "Without the thumb the hand is put back 60 million years in evolutionary terms to the stage when the thumb had no independent movement and was just another digit".¹³ The anatomical and strategic location of the thumb is very important in the functions of the hand which make us different from other primates.

Blast Injuries to the Hand are three times more common from low explosives than from high explosives. Some of the more frequently used explosives include firecrackers, pipe bombs and dynamites. In a significant number of cases, homemade firecrackers were the cause of explosion. The predominance of the right hand in such injuries may be an accident while hurling a cracker or due to mischievous behavior of firing the cracker with bare hands.

Regarding the pathomechanics of blast injury to the hand, the thumb and the index finger play a prime role in pinching or picking up a cracker, supported by little finger, while the rest stabilizes the grip.¹³ The radial aspect of the hand is more frequently involved.¹⁴ The most common pattern of injury comprised of a first web space split with variable degrees of thenar muscle injury, dorsal dislocation of the CMC joint of the thumb, which was occasionally associated with 2nd and 3rd metacarpal injuries.

Whenever an explosion occur, the primary wave occurs in a centrifugal direction radiating from the major point of contact and a secondary negative force sucks in the atmospheric debris into the wound in a centripetal manner. The amplitude of the wave is inversely proportional to the radius or in other words any structure which is of close proximity to the explosion will be affected more. The prime vector acts to split the first web space invariably and closely followed by disruption of carpo metacarpal joint of the thumb causing a dorsal dislocation of the same.¹⁵

Revascularization and replantation in the acute setting is the recommended option if feasible.¹⁴ Replantation was deferred in our case considering the warm ischemia time and clinical

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appearance. Primary debridement followed by primary closure if possible is recommended for all patients.¹⁴ Joint disruptions/ Fractures shall be managed with K-wire fixation on an immediate basis and associated reconstruction. Amputations shall be managed with terminalization operations done either primarily or in a serial fashion.¹⁴ In case of very severe injuries pollicisation may be delayed.¹⁴

Primary pollicisation was done in our case considering the possibility of fibrosis and soft tissue contracture in future and also technically it may be difficult for mobilization when done as a secondary procedure in these instances. Also motivation of our patient who is illiterate is another concern. Early rehabilitation is desired for all cases. But of course we need more experience in this regard whether to wait for the soft tissues and bone to heal and go for a secondary pollicisation at a later date. In our case we preferred primary pollicisation since we had a doubt whether the index finger will survive the waiting period for secondary pollicisation and the patient is willing for both thumb as well as index finger amputation on day of injury itself so we tried to save atleast one of the badly injured fingers.

The plane of the thumb is at right angles to that of other fingers, despite this fact 160 deg rotational transfer was done at osteotomy level taking into consideration that invariably while closure of soft tissues and skin, this angle would slowly return to 120deg and in case of scar contracture may reduce even further.

Adrain et al in his article grasp has described "The best substitution is any one of the fingers, and technically it is possible to move any of the fingers across onto the base of the destroyed thumb. However, the use of any finger other than the index finger produces an indifferent thumb and is best regarded as a surgical triumph and a functional disaster".¹⁵ The translation of an index finger onto a thumb stump is a relatively easy procedure and gives a good functional result.¹⁵

The ring finger was not utilized because we didn't want to touch the relatively uninjured finger and also for reconstruction of first web space index finger pollicisation is the recommended method¹⁵ which is essential for the functional recovery of the hand.

Cortical plasticity and motor relearning play a pivotal role in functional outcome following pollicization. Human cortical plasticity is a complex process that involves the unveiling of previously ineffective connections and sprouting of intact afferents from nearby cortical and/or subcortical territories. we have a large sensory homunculus for our hand in which the thumb and index finger share adjacent locations and a large area of representation when compared to other fingers and it is well known that in case of loss of a digit or extremity adjacent part takes the share of the lost digit in our brain and hence motor as well as sensory re learning /training shall be better if index finger is utilised for pollicisation rather than ring finger.

During our final follow up, the first web space was well preserved and there was a mild to moderate scar contracture of the first web space. Although the pollicised index finger looks deformed at final follow up it acts as an effective opposition post through which the patient could manage his activities of daily living with some difficulties.

In this article, I would like to highlight that although structurally the cosmetic appearance was not completely restored and the hand looks deformed, most of the functions of the hand were restored by this procedure hence although pollicisation of index finger is primarily being

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done for congenital anomalies of the hand we should still keep it in mind and advocate them at situations like this where both the fingers are comprised of vascularity and salvage is desired.

Even a small stump of thumb is useful and every attempt should be made to preserve it or reconstruct it although we speak in terms of bionic hands the height of nature is unreachable and this procedure of pollicisation could give life to a patient and make him/her economically independent and be a useful citizen for the nation.



Figure 1



Figure 2



Figure 3



Figure 4

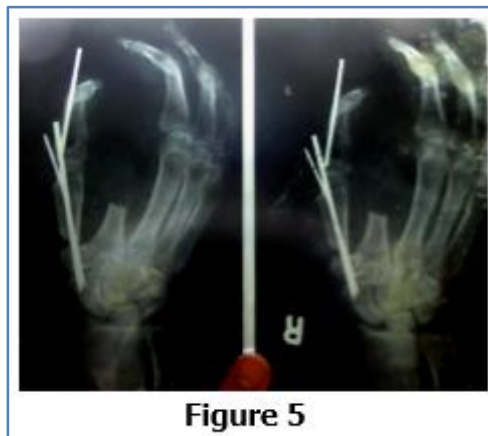


Figure 5

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Figure 6 & 7: Clinical photographs at the end of 3 months



Figure 8



Figure 9



Figure 10

Figure 8, 9 and 10: clinical photo- showing preserved web space of the hand



Figure 11: radiographs at the end of 3 months



Figure 12: radiograph at the end of 3 years showing a solid union

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REFERENCES:

1. Ron Hazani, Rudolf F. Buntic and Darrell Brooks. Patterns in blast injuries to the hand. *Hand (N Y)*. 2009 Mar; 4(1): 44-49.
2. Department of Orthopaedics, E.S.I. Hospital, Jaipur, India. *The Journal of Hand Surgery British & European Volume (Impact Factor: 0.04)*. 09/1988; 13(3):325-7. DOI: 10.1016/0266-7681(88)90101-5.
3. *The Scientific World Journal Volume 2014 (2014)*, Article ID 640430, 13 pages (<http://dx.doi.org/10.1155/2014/640430>) Review Article Management of Major Limb Injuries Vijay Langer Department of Reconstructive and Plastic Surgery, Army Hospital (Research and Referral), New Delhi 110010, India.
4. Immediate pollicization of an amputated index finger. *J Hand Surg.* 1947; 133: 29. Littler JW. Subtotal reconstruction of thumb
5. *J Hand Ther.* 1996 Jan-Mar; 9 (1): 41-6. Current concepts of toe-to-hand transfer: surgery and rehabilitation. Ma HS1, Abdalla el-Gammal T, Wei FC.
6. Rockwood & Green's Fractures in Adults 6th Edition-chapter 16- bone and soft tissue reconstruction.
7. Pulsed Lavage in Wound Cleansing-Kathleen A Luedtke-Hoffmann and D Sue Schafer Texas Woman's University, Dallas.
8. Debridement of Muscle - Wheelless' Textbook of Orthopaedics www.wheelsonline.com/ortho
9. Campbell's operative orthopedics –volume 4: part XVIII-CHAP 79.
10. Green's Operative Hand Surgery by Scott W. Wolfe, MD, Robert N. Hotchkiss, MD, William C. Pederson MD and Scott H. Kozin, MD - Flexor Tendon Reconstruction.
11. Shoelace technique for delayed primary closure of fasciotomies- S S Berman J D Schilling K E McIntyre G C Hunter V M Bernhard Department of Surgery, University of Arizona Health Sciences Center, Tucson. *The American Journal of Surgery (Impact Factor: 2.52)*. 05/1994; 167(4):435-6. DOI: 10.1016/0002-9610(94)90130-9. Source: PubMed.
12. DASH DISABILITY/SYMPTOM SCORE = [(sum of n responses) - 1]/n x 25, where n is equal to the number of completed responses.
(www.orthopaedicscore.com/score/pages/...hand_score_dash.html)
13. *Hands*. Napier JR, Tuttle RH. Princeton: Princeton University Press; 1993. P 55. *J Emerg Trauma Shock*. 2013 Jan-Mar; 6(1): 29–36 Blast injuries to the hand: Pathomechanics, patterns and treatment Souvik Adhikari, Tibar Bandyopadhyay, Tapan Sarkar, and Jayanta Kumar Saha.
14. *Proc (Bayl Univ Med Cent)*. 2000 Oct; 13(4): 343–348. Grasp: Adrian E. Flatt, MD, FRCS, FACS [PMC free article] [PubMed]
15. *Clin Orthop Surg*. 2012 Mar; 4(1): 18-35: Pollicization: the concept, technical details, and outcome: Kozin SH1.

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